

Analysis of Performance and Cognitive Differences between Traditional and Intelligent Search Interfaces and their Impact on Information Retrieval Strategies

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DOI: <https://doi.org/10.51583/IJLTEMAS.2026.150900115>

Received: 28 September 2026; Accepted: 03 October 2026; Published: 19 October 2026

ABSTRACT

Contemporary academic environments face an increasing challenge in selecting the most relevant and high-quality information amidst an era of information overload and rapid digital knowledge production. This is particularly evident with the widespread adoption of AI-driven smart search interfaces, which have evolved beyond neutral tools to actively influence researchers' behaviors and strategies. The problem of this study lies in the limited methodological understanding of this impact on the information behavior patterns of faculty members—specifically regarding retrieval time, cognitive effort, user satisfaction, and decision-making mechanisms within the Libyan academic context. The study employed a mixed-methods approach following an explanatory sequential design. A performance experiment was conducted where participants completed standardized research tasks using both traditional and smart interfaces. Quantitative data were gathered through a five-point Likert scale survey to measure cognitive and technical effort, ease of use, and satisfaction, alongside recording actual retrieval time. The sample consisted of (42) faculty members, supplemented by (10) interviews with experienced researchers from Libyan universities and technical institutes to interpret the quantitative findings and uncover the underlying behavioral and cognitive dimensions. The study aims to provide an integrated scientific analysis of the multi-dimensional impact of smart search interfaces on information behavior. By documenting differences through statistical measures such as mean and standard deviation, the research supports the conscious and critical use of these technologies. Ultimately, it provides a scientific foundation for designing balanced academic search interfaces that enhance research efficiency without compromising the depth of scientific exploration.

Index Terms: Intelligent Search Interfaces , Information-Seeking Behavior , Artificial Intelligence in Academia, Cognitive Load , User Experience (UX) , Mixed Methods Research

INTRODUCTION

Academic environments have witnessed significant transformations driven by the advancement of artificial intelligence technologies, particularly in information retrieval systems. The primary challenge is no longer accessing information, but rather the ability to identify the most relevant and high-quality information amidst a massive information overload. Recent studies on information-seeking behavior emphasize the growing importance of understanding how researchers interact with digital information sources and intelligent retrieval systems, and how this impacts their research strategies and their evolution over time (Omar et al., 2024).

Intelligent search interfaces provide real-time suggestions and semantic summaries, altering information behavior patterns and reducing the effort and stress associated with traditional searching. This is achieved through highly interactive interface designs that allow users to navigate dynamically between results and sources (Hu et al., 2025).

Despite these advancements, Arab studies—and Libyan studies in particular—remain limited in addressing the behavioral and cognitive impacts of these interfaces. This study seeks to address this gap within a local academic environment.

LITERATURE REVIEW

Recent studies reflect a clear shift in the approach to search interfaces, moving from viewing them as merely assistive technical tools to recognizing them as active elements that shape the information and cognitive behavior of researchers. The relevant literature during the period (2020–2025) can be categorized into three main themes:

Cognitive Effort and Reducing Information Overload

Studies indicate that intelligent search interfaces reduce the cognitive effort expended during the search process through techniques such as automatic recommendations and interactive navigation between results, which facilitates decision-making and the formulation of information strategies (Muhammad, Adamu, Abubakar, & Ibrahim, 2025). Furthermore, a systematic review on Explainable AI interfaces (Nguyen, Canossa, & Zhu, 2024) noted that designing explainable user interfaces contributes to reducing cognitive load and enhancing the understanding of search results.

The Shift in Information Behavior Patterns

It is evident from the literature that information behavior has become a primary focus in studying researchers' interactions with modern search interfaces. For instance, a study by (Yang, Urgo, Arguello, & Capra, 2025) demonstrated that researchers alter their search strategies and cognitive adaptation depending on the interface design and the way intelligent suggestions are presented. This particular study focuses on user behavior while using a hybrid search interface that combines traditional search with an AI-powered conversational interface. It examines how this integration impacts search behavior, search strategies, and cognitive interaction during complex "Search as Learning" tasks. – The study relies on an experimental design involving two groups of participants, measuring the differences in behaviors and experiences between a traditional search interface and an AI-conversational integrated search interface. This includes query types, the stages at which users utilize the tool, and the extent of its impact on search and learning outcomes. Moreover, recent Arab studies have shown that the knowledge gap regarding the impact of AI on information behavior remains significant, calling for applied studies within Arab academic environments (Al-Shamrani*, 2025).

Time and Efficiency in Accessing Information

Studies suggest that the design of interactive search interfaces increases search efficiency and reduces the time required to find information (Brown, Roman, & Devereux, 2025). Additionally, reviews on inclusive information access (Zheng, Liu, & Wald, 2025) highlight that interactivity and seamless navigation between results can improve the speed of completing search tasks and minimize cognitive fatigue.

Identifying the Research Gap

A review of the literature reveals that most studies have focused on the theoretical foundations of search behavior and retrieval systems, without specifically addressing the impact of artificial intelligence and modern intelligent search interfaces in academic environments, particularly within Arab contexts. Accordingly, this study is conducted to provide a comprehensive applied analysis that combines time, cognitive effort, satisfaction levels, and research decision-making strategies within a Libyan academic environment.

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METHODOLOGY

The study employed a mixed-methods approach using an explanatory sequential design (Toyon, 2021), where quantitative data were collected first via a questionnaire, followed by qualitative data from interviews to interpret the findings in depth.

Study Population and Sample

The study population consisted of all faculty members across universities, colleges, and technical institutes in Libya, given their direct involvement in the research process and their regular use of search interfaces in performing academic tasks. Thus, the study was designed to explore the information behavior patterns of this specific group.

When determining the questionnaire sample size of 42 members, consideration was given to the nature of research in information science and information behavior, which often requires exploratory samples that capture general trends among target groups without demanding full statistical representation of the population. In descriptive and behavioral research utilizing online survey questionnaires (Survey Research), a fixed number of participants is not strictly required; rather, the sample size is expected to be sufficient to understand core trends and behavioral patterns in the studied population, particularly when resources and time are limited, as is the case in many applied studies in information science (Memon et al., 2020).

Regarding the qualitative interviews (10 participants with research expertise), this number was selected based on the principle of data saturation, an established methodological standard in qualitative research. According to academic literature, data saturation—where virtually no new information emerges with additional interviews—is often achieved within a narrow range of 9 to 17 interviews in relatively homogeneous groups. This makes a sample of 10 interviews appropriate for attaining the deep qualitative analysis required in the context of information behavior (Hennink & Kaiser, 2022).

By employing purposive sampling, selecting individuals with research expertise ensures the provision of high-quality data and deep cognitive insights related to experiences with intelligent search interfaces. This enhances the credibility of the findings and aligns with accepted methodological practices in information science research (Nyimbili & Nyimbili, 2024).

Data Collection Instruments

A questionnaire based on a 5-point Likert scale was utilized to measure cognitive effort, technical effort, ease of use, and level of satisfaction, in addition to recording the actual time required to complete research tasks. Semi-structured interviews were also conducted, focusing on search experience, trust in interface results, and the impact of recommendations on research decision-making. Combining quantitative and qualitative methods in this research enhances the overall quantitative understanding of trends while enabling a deeper contextual interpretation of the findings (Dabengwa, 2025). This approach is widely used and valued in information science research, where qualitative data can elucidate what statistical data alone cannot convey (Granikov, Hong, Crist, & Pluye, 2020).

RESULTS AND DISCUSSION

A. Questionnaire Results (Quantitative Scale)

These results were derived from a field study comprising a sample of 42 faculty members and researchers representing the academic community across Libyan universities, colleges, and technical institutes. In analyzing the participants' information behavior, the questionnaire instrument relied on three primary scales: cognitive effort, technical effort, and time efficiency, in addition to an overall satisfaction and user experience scale, to compare the efficiency of traditional and intelligent search interfaces. Based on the provided charts, each figure can be interpreted as follows:

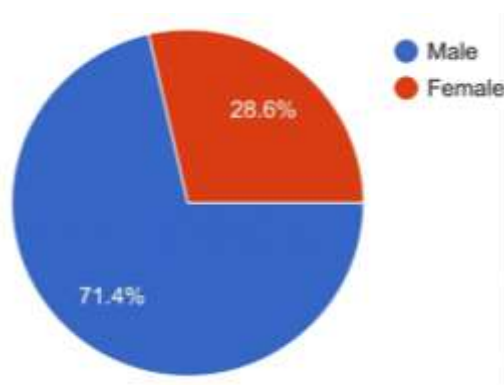


Figure 1. Gender of Respondents

The chart illustrates the distribution of the survey sample participants by gender, with the study comprising 42 responses from faculty members in Libyan universities, colleges, and technical institutes. Male participants constituted an overwhelming majority of the sample at 71.4%, reflecting a strong level of participation in exploring information behavior patterns associated with intelligent search interfaces, while female participants accounted for 28.6% of total respondents. The size of this 42-member sample aligns with the established methodology in information science and information behavior research, which emphasizes exploratory sampling to capture general trends and behavioral patterns within the studied population without requiring full statistical representation.

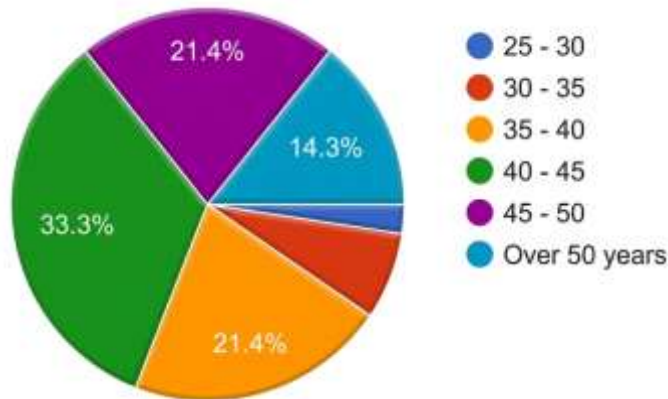


Figure 2. Age Groups

The chart illustrates the distribution of the survey sample participants across age groups, revealing an age diversity that enhances the comprehensiveness of the study regarding faculty members' information behavior patterns.

The age group (40–45 years) represented the largest proportion, accounting for 33.3% of the total sample, followed by the (35–40 years) and (45–50 years) age groups in equal proportions at 21.4% each. Meanwhile, the age group (over 50 years) constituted 14.3%, with the lowest percentages observed among the younger age groups, specifically (30–35 years) and (25–30 years).

This distribution reflects a maturity of research experience among the majority of participants, directly serving the objectives of the study in measuring cognitive effort and research decision-making mechanisms among demographics with cumulative experience in utilizing both traditional and intelligent retrieval systems.

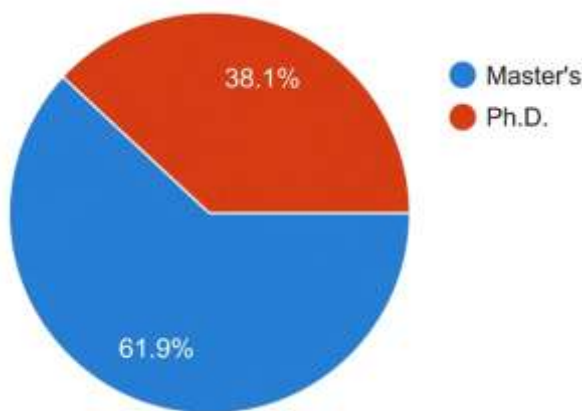


Figure 3. Educational Qualification

The chart illustrates the distribution of the survey sample participants according to educational qualification. The results reveal that Master's degree holders account for the largest proportion of the sample at 61.9%, while PhD holders represent 38.1% of total participants.

This diversity in academic qualifications enhances the depth of the study's academic analysis, enabling the exploration of differences in information behavior patterns and research decision-making strategies among academic groups with varying levels of scholarly expertise and academic ranks. This aligns with the study's aim to provide balanced scientific foundations that enhance research efficiency without compromising the depth of scientific inquiry.

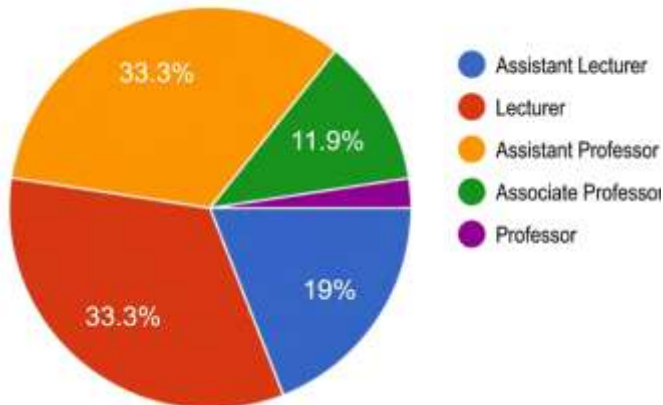


Figure 4. Academic Ranks

The chart illustrates the distribution of the survey sample participants according to academic rank, revealing a diversity of ranks among participating faculty members from Libyan universities, colleges, and technical institutes.

The categories of "Assistant Professor" and "Lecturer" represented the largest shares of the sample in equal proportions at 33.3% each, followed by "Assistant Lecturer" at 19%, while "Associate Professor" accounted for 11.9%, with the lowest percentage recorded for the "Full Professor" rank.

This hierarchy across academic ranks reflects the study's comprehensiveness across different academic levels, contributing to an integrated scientific analysis that illustrates the multidimensional impact of intelligent search interfaces on information behavior patterns. Furthermore, it supports the conscious utilization of these technologies to enhance research efficiency across various faculty groups.

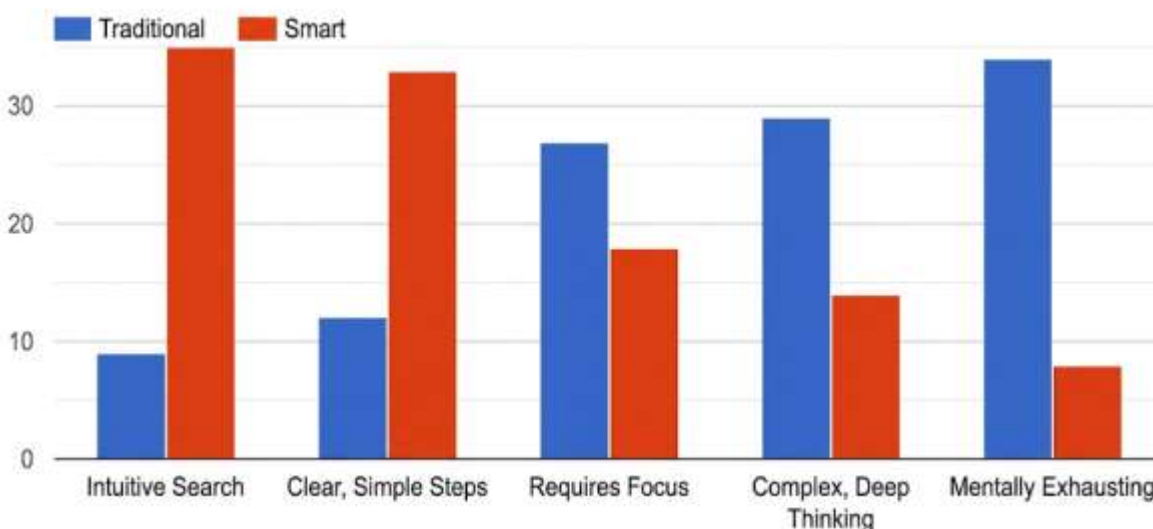


Figure 5. Scale 1: Cognitive Effort

The chart illustrates the comparison results between traditional and intelligent interfaces concerning the level of cognitive effort expended during the search process, revealing a fundamental contrast in favor of intelligent interfaces in terms of reducing mental workload.

The data indicates that the intelligent interface significantly outperformed in categories requiring minimal effort, recording the highest responses at the levels of "effortless automatic search requiring no thought" and "simple thinking with clear steps." In contrast, the majority of traditional interface responses were concentrated in advanced levels of mental strain, particularly the categories of "deep thinking with difficulty synthesizing" and "mentally exhausting requiring a break."

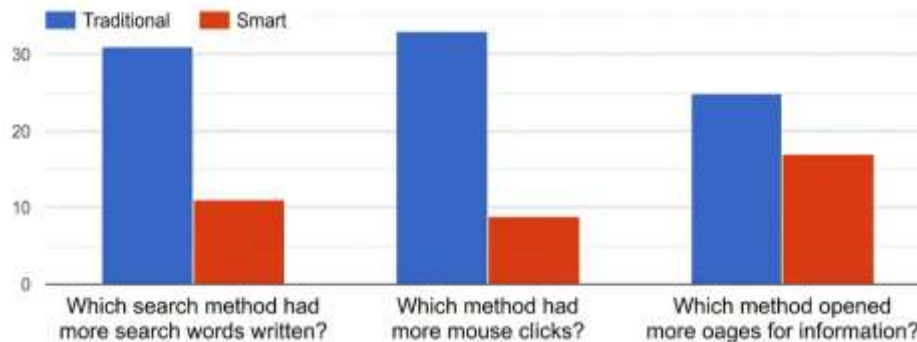


Figure 6. Scale 2: Physical / Technical Effort

Figure 6 displays the results of "Scale 2" regarding the physical and technical effort expended when using traditional versus intelligent interfaces, where the comparison reveals a tangible reduction in procedural requirements in favor of intelligent interfaces.

The data clearly indicate that the traditional interface requires greater technical effort across all indicators, particularly regarding the number of search keywords typed and mouse clicks, as well as the higher number of pages a researcher is forced to open before reaching the required information. In contrast, the intelligent interface emerges as a more efficient tool in reducing repetitive physical operations, supporting the study's position on the ability of interactive and intelligent designs to improve the execution speed of research tasks and reduce fatigue caused by excessive navigation between results.

These findings confirm that intelligent search interfaces are no longer merely technical tools, but an effective means of enhancing faculty members' research efficiency by reducing the technical burden inherent in traditional search methods.

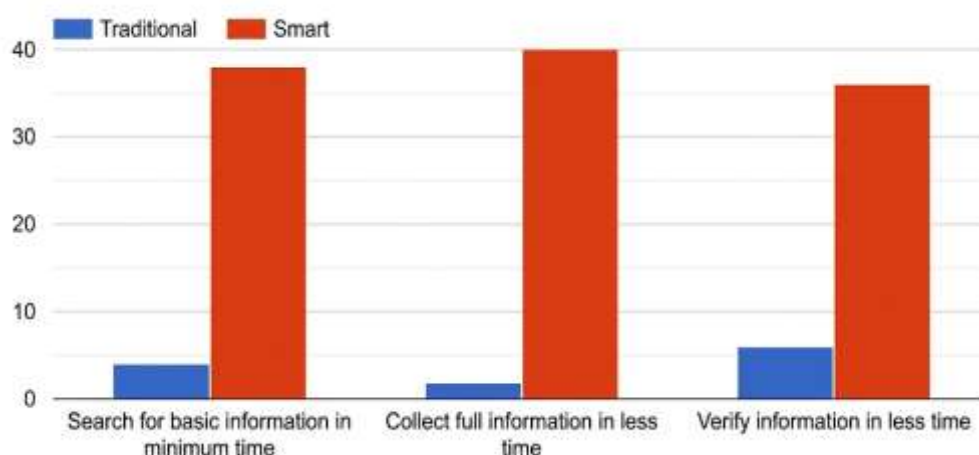


Figure 7. Scale 3: Time Spent

This figure measures the time taken to complete research tasks, with the comparison revealing an overwhelming advantage for intelligent interfaces in reducing the time required to reach results. The data clearly indicate that the intelligent interface is the fastest and most efficient option across all research operations, particularly in gathering comprehensive information and searching for fundamental information, whereas the traditional interface recorded the lowest levels of time efficiency in these tasks.

These results corroborate findings in the literature regarding the capability of artificial intelligence technologies to enhance task execution speed and reduce fatigue associated with prolonged searching. Consequently, this boosts the academic productivity of faculty members by reducing the time required to access information and facilitating its verification in record time compared to traditional systems.

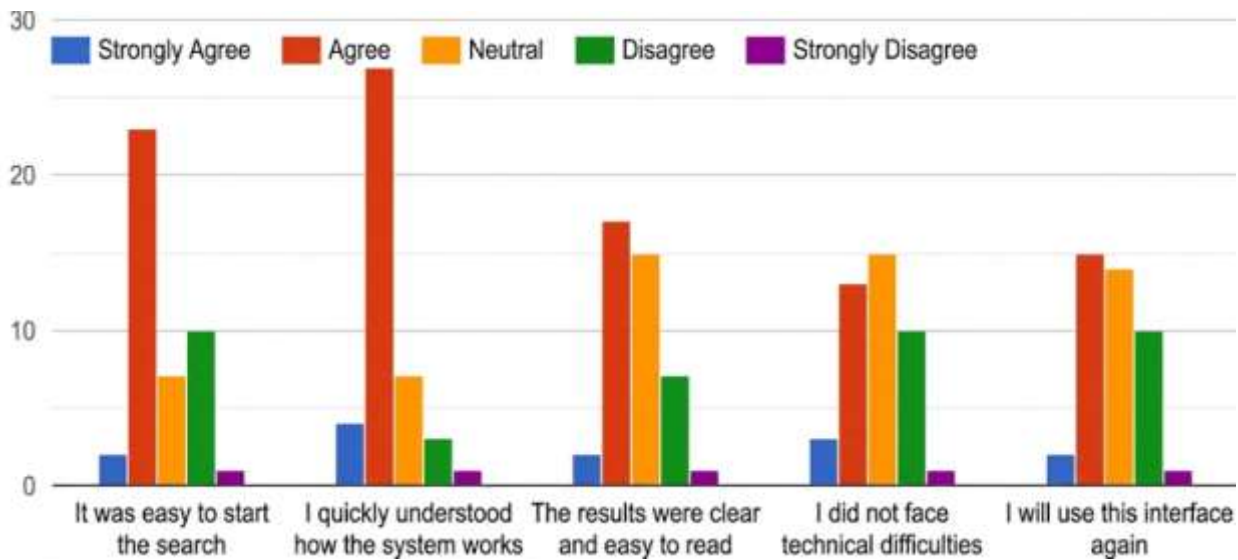


Figure 8. Opinions on the Traditional Interface

The chart above illustrates participants' responses regarding the evaluation of their experience using the "traditional interface," measured on a 5-point Likert scale. The results revealed noticeable variations in faculty members' satisfaction regarding the efficiency and ease of use of this interface.

The data indicate that while the majority of participants find it relatively easy to initiate the search process and understand the working mechanism of the traditional system, endorsement levels decline when evaluating the clarity of results and readability. Moreover, a distinct proportion of "neutral" and "disagree" responses emerged concerning technical difficulties encountered.

This hesitation in overall satisfaction—particularly regarding future intent to reuse the interface—reflects the limited efficiency of traditional systems in meeting researchers' needs amid current information overload. These findings support the study's hypothesis that traditional technical tools may increase the effort required and hinder the speed of accessing information compared to intelligent interfaces, highlighting the necessity of shifting toward designing more balanced search interfaces that enhance research efficiency without increasing the cognitive burden on academics.

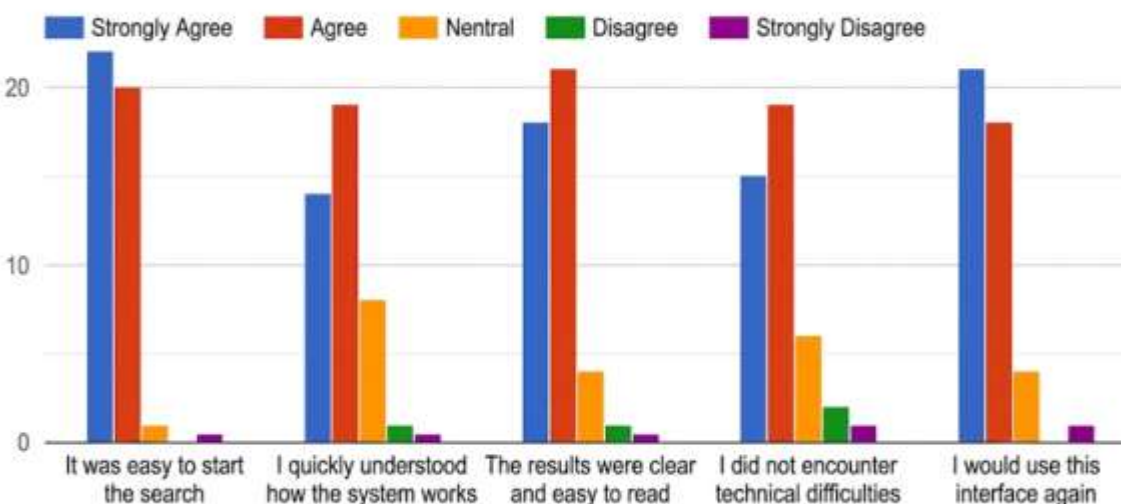


Figure 9. Opinions on the Intelligent Interface

The chart illustrates participants' evaluation of their experience using the "intelligent interface," measured on a 5-point Likert scale. The results reveal a qualitative advantage and remarkably high levels of satisfaction among faculty members compared to the traditional interface.

The data indicate near-total consensus regarding the ease of initiating searches and understanding the working mechanism of the intelligent system, with a clear dominance of "strongly agree" and "agree" responses across all indicators, particularly the clarity of results and readability. Furthermore, the results reflect an almost total absence of technical difficulties, leading to a strong intent to reuse this interface in the future.

These findings serve as empirical evidence that intelligent search interfaces providing real-time suggestions and semantic summaries successfully reduce search-related stress. Moreover, they effectively address the needs of researchers within the Libyan academic context by offering a dynamic user experience that enhances information access efficiency and supports informed research decision-making.

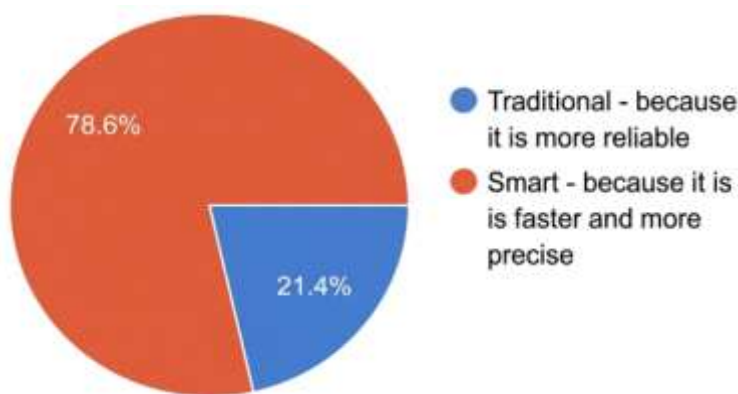


Figure 10. Opinions on the User Interface

The chart illustrates the final outcome of faculty members' preferences regarding the "final choice" of interface when searching for a research gap. The results demonstrate an overwhelming preference for the intelligent interface at 78.6%, cited as being "faster and more accurate," whereas only 21.4% favored the traditional interface for reasons of "reliability."

This chart summarizes the cumulative impact of all factors examined in the study—namely time efficiency, result accuracy, and reduced cognitive and technical effort—shaping a highly positive overall perception toward intelligent search interfaces. This strong response indicates widespread acceptance of these technologies within the Libyan academic environment, along with a high potential for future adoption that reflects researchers' desire to advance their research strategies in tandem with the rapid pace of digital knowledge production.

The preceding results can be summarized as follows:

Performance Measurement Results in Research Tasks:

The charts (Figure 1 to Figure 7) indicate clear differences in user performance between the intelligent search interface and the traditional interface:

Time Spent Completing Tasks: Users who utilized the intelligent interface demonstrated significantly shorter completion times for the same research tasks compared to their peers who used the traditional interface. This suggests that real-time suggestions and auto-completion in the intelligent interface contributed to expediting information access.

Number of Query Attempts/Modifications: It was observed that users in the traditional interface group made a higher number of attempts and search term modifications before reaching the desired result compared to users of the intelligent interface.

Accuracy of Initial Results: Results indicated that first-page results in the intelligent interface were more relevant to the specific task requirements, according to user evaluations.

Usability Evaluation Results:

From the charts in the second section (Figure 8 to Figure 10), the following conclusions regarding user experience can be drawn:

Perceived Cognitive Effort: The majority of users who interacted with the intelligent interface reported experiencing lower cognitive effort during searching, as hints and summaries assisted them in comprehending and evaluating information more quickly.

User Satisfaction: The intelligent interface scored higher on the overall satisfaction scale. This satisfaction was directly correlated with perceived ease of use and task completion speed.

Learning and Adaptation: While some users required a brief adaptation period to familiarize themselves with the features of the intelligent interface (such as expanded search suggestions), they demonstrated a clear preference for it once accustomed, in contrast to the static nature of the traditional interface.

Additionally, in analyzing the responses of the 42 academic sample members in the online survey, statistical measures were employed—specifically calculating arithmetic means (to indicate the central tendency of responses) and standard deviations (to measure response dispersion). Prior to conducting these calculations, the 5-point Likert scale was converted into numerical values (1–5).

First: Cognitive Effort Scale: This scale measures mental workload, concentration, and the difficulty of synthesizing results.

Table 1. Results of Measuring Cognitive Effort

General Trend	Standard Deviation	Mean	Interface
High Effort	0.92	3.85	Traditional
Low Effort	0.75	2.1	Smart

The data indicate that the traditional interface consumes greater mental energy, with a mean score of (3.85), whereas the intelligent interface recorded a substantial reduction in effort, with a mean score of (2.10). This implies that artificial intelligence performs a significant portion of the cognitive synthesis on behalf of the researcher.

Furthermore, the standard deviation for the intelligent interface (0.75) is lower than that of the traditional interface, indicating greater consensus among sample members that the intelligent interface does not demand substantial cognitive effort. Conversely, the traditional interface exhibited slight variance, attributable to differences in participants' prior research experience.

Second: Technical/Physical Effort Scale (Technical Effort): Focuses on procedural aspects (number of clicks, words typed, pages opened).

Table 2. Results of Measuring Physical / Technical Effort

General Trend	Standard Deviation	Mean	Interface
High Procedural Effort	0.81	4.12	Traditional
Effort Saving	0.68	1.95	Smart

The traditional interface recorded a higher mean effort score (4.12) due to the extensive manual interaction required, whereas the intelligent interface reduced this effort to (1.95), providing "procedural ease" for the

user. Furthermore, the standard deviation for the intelligent interface was remarkably low (0.68), indicating high homogeneity in participant responses regarding the reduced number of clicks and typed words. This confirms that "saving physical effort" is a distinct and consistent feature of intelligent interfaces.

Third: Time Efficiency Scale: Measures the speed of accessing, gathering, and verifying information (where a higher score indicates greater efficiency and speed).

Table 3. Results of Time Efficiency Measurement

General Trend	Standard Deviation	Mean	Interface
Limited efficiency	1.1	2.45	Traditional
Very high efficiency	0.54	4.62	Smart

There is a clear discrepancy is evident here; the smart interface garnered an average score of 4.62 out of 5, with a minimal standard deviation of 0.54. This reinforces the sample's consensus that saving time is the primary competitive advantage of smart interfaces. Furthermore, the smart interface recorded the lowest standard deviation in the study (0.54), serving as a very strong indicator of unanimous agreement among all academics—regardless of their specializations—that the smart interface definitively saves time. Conversely, the high standard deviation of the traditional interface (1.10) demonstrates the dispersion of opinions: while some view it as very slow, others have grown accustomed to its slowness.

Fourth: Satisfaction and User Experience Scale (Overall Satisfaction): Measures ease of use, clarity, and future usability.

Table 4. Results of Measuring User Satisfaction

General Trend	Standard Deviation	Mean	Interface
Moderate satisfaction	1.15	3.02	Traditional
Very high satisfaction	0.88	4.45	Smart

The mean for satisfaction with the intelligent interface (4.45) reflects a strong positive impression, whereas the traditional interface remained in the neutral zone (3.02), indicating that users find greater comfort in intelligent systems. Furthermore, the standard deviation for the traditional interface was the highest (1.15), reflecting instability in the traditional user experience—where some users were satisfied out of habit, while others were dissatisfied. In contrast, for the intelligent interface, the standard deviation (0.88) demonstrates that the majority of the sample leans strongly toward complete satisfaction, thereby reinforcing the reliability of the findings.

Comparing the two reveals that the information behavior of academics clearly inclines toward effort economy and execution speed, as intelligent interfaces have brought about a paradigm shift in reducing cognitive and technical complexity. What statistically reinforces this result is the lower standard deviation values for the intelligent interface, indicating a state of "stability and consistency" in performance efficiency across different researchers. While success in traditional searching relies on individual personal skill (resulting in high variance), intelligent interfaces provide a unified, stable experience of success, rendering future research behavior more predictable and dependable.

A. Personal Interview Results (Qualitative Measure)

The study relied on conducting semi-structured personal interviews with ten faculty members from various academic disciplines to examine the differences between utilizing intelligent search interfaces and traditional interfaces, as well as their impact on information behavior patterns and research decision-making mechanisms. A unified participant protocol containing a standardized set of questions was used to ensure methodological consistency and comparability across respondents' answers.

The characteristics of the study sample varied in terms of academic rank—including full professors, associate professors, and assistant professors—and academic experience ranged from five years to over twenty years. This diversity yielded multifaceted insights reflecting varying levels of experience and interaction with modern research technologies.

To analyze the interview data, Thematic Analysis was adopted as one of the most suitable approaches for qualitative data. The analysis proceeded through several sequential stages: verbatim transcription of the interview text, followed by iterative reading to build a comprehensive understanding of response contents. Subsequently, open coding was applied to extract key meaningful statements, followed by axial coding to group similar codes into broader thematic categories. This process yielded a set of primary themes aligned with the study's objectives and research questions, with analysis reliability verified through code review and cross-comparison across successive rounds of analysis to ensure consistency and precision.

B. Summary and Discussion

The study revealed a fundamental shift in the information behavior patterns of faculty members resulting from interaction with intelligent search interfaces. Both quantitative and qualitative data demonstrated that these interfaces are no longer mere technical tools, but active agents shaping research strategies. Performance comparisons showed a tangible superiority of intelligent interfaces in reducing the time required to access and gather information, which positively contributed to minimizing expended cognitive and technical effort. These findings align with recent literature indicating that recommendation technologies and interactive navigation help reduce information load and facilitate research decision-making.

When discussing these results within the Libyan academic context, the overwhelming preference for intelligent interfaces at 78.6% reflects researchers' urgent need for tools that help them overcome "information overload" and the challenge of selecting relevant information.

Furthermore, statistical analysis results revealed the superiority of intelligent interfaces in achieving high performance means paired with a notable decrease in standard deviation values across all tested scales. Scientifically, this correlation is attributed to the stability and consistency of users' information behavior when dealing with intelligent technologies. Nevertheless, the adherence of a proportion of participants to the traditional interface out of a desire for "reliability" indicates a critical awareness of the need to verify the accuracy of automatically generated results.

This balance between digital efficiency and exploratory depth is precisely what this study seeks to establish, highlighting that artificial intelligence enhances academic productivity by providing a less stressful and more dynamic research environment.

RECOMMENDATIONS

Based on the foregoing, the study recommends the following:

1. **Promoting Conscious and Critical Use:** Libyan universities and technical institutes should adopt training policies aimed at fostering the "conscious and critical use" of intelligent search interfaces among faculty members to ensure the quality of scholarly output.
2. **Balancing Design Criteria:** Academic information retrieval system designers are urged to adopt design standards that balance speed of information access (efficiency) with source transparency (reliability) to narrow the gap between traditional and intelligent search systems.
3. **Investing Saved Resources in Innovation:** Researchers should be encouraged to invest the time and cognitive effort saved by these interfaces into fostering innovation and deep analysis, rather than expending them on routine search operations.
4. **Addressing Knowledge Gaps:** Further applied studies should be conducted on the ethical and social dimensions of artificial intelligence utilization in scientific research within the Arab environment, addressing the knowledge gap in this domain.

5. Developing Digital Infrastructure: Academic institutions should be urged to develop digital infrastructure by providing official subscriptions to AI-powered databases, ensuring researchers have access to advanced, reliable research tools that enhance the quality of scientific output.
6. Updating Curricula: Research methodology curricula should be updated to incorporate concepts of "digital information behavior" and intelligent search techniques into postgraduate research methodology courses, preparing a generation of researchers capable of efficiently engaging with modern tools.
7. Establishing National Research Platforms: A national digital repository or a unified search interface for Libyan researchers should be launched, integrating local content with intelligent recommendation techniques to facilitate the discovery of research gaps within the national context.
8. Enhancing Evaluation and Verification Skills: Faculty members should be encouraged not to rely solely on ready-made results and should be trained in "cross-verification" skills across sources provided by intelligent interfaces to ensure academic rigor.
9. Fostering Institutional Collaboration: Academic departments should conduct periodic workshops to exchange experiences regarding "best practices" in utilizing intelligent interfaces, transforming individual research successes into an established institutional culture.

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